REMARKS

Claims 1-10 are pending in this application. Claims 1 and 7-10 have been amended herein. Reconsideration in view of the following remarks is respectfully requested.

Applicants' representatives appreciate the courtesies extended by the Examiner during the personal interview held on March 10, 2005.

During the interview, the rejection of claims 1-6 under 35 U.S.C. § 112, first paragraph was discussed and a proposed amendment to overcome this rejection was proposed. In addition, Applicants' representatives discussed in detail claims 1 and 10 and proposed possible amendments to the claims. The substance of the interview is reflected in the remarks below.

Claim Rejections - 35 USC § 112

Claims 1-6 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Applicants respectfully traverse the rejection.

The Examiner contends that the limitation "the auxiliary electrode lacks any part that prevents a drift of electrons in the vicinity of the auxiliary electrode in a direction parallel to a front surface of the auxiliary electrode and a back surface of the auxiliary electrode," is not supported by the specification as originally filed. Applicants respectfully disagree. However, in order to advance prosecution, claim 1 was amended to remove the negative limitation "lacks any part ..." Claim 1 now recites, *inter-alia*, "wherein said first electrode and said auxiliary electrode are supplied with radio frequency signals having different phases to establish a flow of electrons substantially parallel to the front surface of said auxiliary electrode and substantially parallel to the back surface thereof." Support for the amendment to claim 1 is provided throughout the original disclosure. For example, the Examiner's attention is directed to page 10 and page 11 of the specification.

Consequently, Applicants respectfully submit that claims 1-6 are in full compliance with § 112, first paragraph. Therefore, withdrawal of the rejection of claims 1-6 under § 112, first paragraph is respectfully requested.

Claim Rejections - 35 USC § 102

Claim 10 was rejected under 35 U.S.C. § 102(e) over US Patent No. 6,232,236 to Shan et al. ("Shan"). Applicants respectfully traverse the rejection.

Claim 10 recites, *inter-alia*, "a disk-shaped auxiliary electrode provided on an outer periphery of said first electrode to excite plasma in a vicinity of the auxiliary electrode, the auxiliary electrode having substantially planar front and back surfaces, wherein the auxiliary electrode is operably connected to the second power source, and wherein electrons in the plasma drift from the front surface of said auxiliary electrode to the back surface thereof and from the back surface of said auxiliary electrode to the front surface thereof, and the electrons in the plasma circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof, wherein said first electrode is supplied with a first radio frequency and said auxiliary electrode is supplied with a second radio frequency and wherein the first and the second radio frequencies are equal to each other and have different phases thereof."

Shan discloses a process kit ("auxiliary electrode") 220 having a "L-shape." In contrast, claim 10 requires that the auxiliary electrode be a disk-shaped electrode having substantially planar front and back surfaces. Clearly, the "L-shaped" structure of Shan's process kit 220 is not disk-shaped and does not have substantially planar front and back surfaces.

Furthermore, by operably connecting the first electrode to a first power source and operably connecting the auxiliary electrode to a second power source and supplying the first electrode with a first radio frequency and the auxiliary electrode with a second radio frequency, the first and the second radio frequencies being equal to each other but with different phases, the electrons in the plasma are permitted to drift from the planar front surface of the disk-shaped auxiliary electrode to the planar back surface of the disk-shaped auxiliary electrode and vice versa.

Contrary to Examiner's contention, the apparatus of Shan is not capable of producing the plasma electron drift, as claimed. Indeed, due to the "L-shape" structure of Shan's process kit 220, the electrons cannot drift from the top surface 222 to the bottom surface 224, much less drift from the bottom surface 224 to the top surface 222, because the extension 226 hinders the movement of electrons. Claim 10 requires that electrons in the plasma drift from a front surface of the auxiliary electrode to a back surface thereof and from the back surface of the auxiliary electrode to the front surface thereof, and requires that the electrons circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof. The apparatus of Shan clearly does not allow the electrons to drift and circulate in the manner recited by claim 10. In fact, as indicated by the arrows

shown in Figure 2 of Shan, the electrons drift from the secondary plasma 235 above the top surface 222 of process kit 224 to the primary plasma 230 above the wafer 116 (see col. 4, lines 50-59 in Shan).

Moreover, Shan does not disclose, teach or suggest using a magnetic field generator configured to apply a static magnetic field to a surface of the substrate to which the plasma process is applied. In addition, the power source 302 (Fig. 3) in Shan delivers power to both the wafer support electrode 215 to drive the primary plasma and to the process kit 220 to drive the secondary plasma. The power source 302 provides two RF signals, with a single frequency, to the wafer support and the process kit (see col. 5, lines 10-25). Shan is completely silent about the phase of the two RF signals provided to the wafer support and the process kit.

Since Shan does not describe or recite each and every feature as recited by claim 10, Shan cannot be said to anticipate claim 10. Therefore, Applicants respectfully submit that claim 10 is patentable and respectfully request that the rejection of claim 10 under § 102(e) be withdrawn.

Claim Rejections - 35 USC § 103

Claims 8 and 9 were rejected under 35 U.S.C. § 103(a) over Shan in view of US Patent No. 5,949,409 to Dornfest et al. ("Dornfest"). Applicants respectfully traverse the rejection.

As stated above with respect to claim 10, Shan does not disclose, teach or suggest "a disk-shaped auxiliary electrode provided on an outer periphery of said first electrode to excite the plasma in a vicinity of the auxiliary electrode, the auxiliary electrode having substantially planar front and back surfaces," as recited in claim 8 and 9. Shan process kit ("auxiliary electrode") 220, has a "L-shape," and the "L-shaped" structure of Shan's process kit 220 is not disk-shaped and does not have substantially planar front and back surfaces.

Furthermore, Shan does not disclose, teach or suggest "wherein electrons in the plasma drift from the front surface of said auxiliary electrode to the back surface thereof and from the back surface of said auxiliary electrode to the front surface thereof, and the electrons in the plasma circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof," as recited in claims 8 and 9.

As stated above, due to the "L-shape" structure of the process kit 220 of Shan, the electrons cannot drift from the top surface 222 to the bottom surface 224, drift from the

bottom surface 224 to the top surface of the process kit 220 and circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof. The presence of the extension 226 does not allow the movement of electrons as in the manner recited in claims 8 and 9. Furthermore, as conceded in the Office Action, Shan does not disclose or suggest covering the auxiliary electrode with an insulating material.

Dornfest fails to overcome the deficiencies of Shan. Dornfest does not disclose, teach or suggest, among other things, "a disk-shaped auxiliary electrode provided on an outer periphery of said first electrode to excite the plasma in a vicinity of the auxiliary electrode, the auxiliary electrode having substantially planar front and back surfaces," as recited in claim 8 and 9. Furthermore, Dornfest does not disclose, teach or suggest "electrons in the plasma drift from the front surface of said auxiliary electrode to the back surface thereof and from the back surface of said auxiliary electrode to the front surface thereof, and the electrons in the plasma circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof," as recited in claims 8 and 9.

Dornfest merely applies a ceramic protection (insulating material) to metal surfaces in a plasma processing chamber to prevent or inhibit attack of the heated metal surfaces by chemically aggressive species generated in a plasma during processing of materials (see Abstract of Dornfest). Dornfest merely applies the insulating material to protect an electrode from the plasma atmosphere. In contrast, in claims 8 and 9, the front surface of the auxiliary electrode is covered by an insulating material. As a result, a difference in plasma density is created between the substantially planar front surface of the auxiliary electrode (covered with the insulating material) and the substantially planar back surface of the auxiliary electrode. This difference in plasma density is at least partially responsible, in conjunction with operably connecting the auxiliary electrode to a second power source and operably connecting a first electrode on which a substrate is positioned to a first power source, for causing the electrons to drift between the front and the back surfaces of the auxiliary electrode.

Consequently, neither Shan nor Dornfest, alone or in combination, disclose, teach or suggest the subject matter recited by claims 8 and 9. Therefore, Applicants respectfully submit that claims 8 and 9 are patentable over the combination of Shan and Dornfest. Reconsideration and withdrawal of the rejections of claims 8 and 9 are respectfully requested.

Claim 7 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Shan in view of WO 98/39500 to Ohmi et al. ("Ohmi"). Applicants respectfully traverse this rejection.

Claim 7 recites, *inter-alia*, "supplying radio frequency signals with different phases to the first electrode and the auxiliary electrode, thereby creating a difference in plasma density between a front surface of the auxiliary electrode and a back surface of the auxiliary electrode to cause electrons in the plasma to drift from the front surface of said auxiliary electrode to the back surface thereof and from the back surface of said auxiliary electrode to the front surface thereof, and to cause the electrons in the plasma to circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof."

As discussed above with respect to claim 10, Applicants submit that Shan does not disclose, teach or suggest "supplying radio frequency signals with different phases to the first electrode and the auxiliary electrode, thereby creating a difference in plasma density between a front surface of the auxiliary electrode and a back surface of the auxiliary electrode to cause electrons in the plasma to drift from the front surface of said auxiliary electrode to the back surface thereof and from the back surface of said auxiliary electrode to the front surface thereof, and to cause the electrons in the plasma to circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof." Furthermore, as conceded in the Office Action, Shan does not disclose or suggest a plasma processing method including applying a static magnetic field.

Ohmi does not cure the deficiencies noted above with respect to Shan. Ohmi discloses a plasma etching device which has an auxiliary electrode and a magnetic device for applying a magnetic field to enable generation of uniform density plasma.

The auxiliary electrode of Ohmi is attached to the electrode substrate holder (see Figure 1 in Ohmi). The back surface of the auxiliary electrode is in contact with the surface of the chuck. Hence, the electrons generated in the plasma and guided by the magnetic field cannot drift from the front surface of the auxiliary electrode to the back surface of the auxiliary electrode, because the back surface of the auxiliary electrode is not accessible to the flow of electrons. Furthermore, the chuck in Ohmi is supplied with a radio frequency signal (110) but the auxiliary electrode is not supplied with a radio frequency signal having a different phase than radio frequency signal (110). Consequently, Ohmi does not disclose,

teach or suggest supplying radio frequency signals with different phases to the first electrode and the auxiliary electrode.

Moreover, there is no suggestion in either Shan or Ohmi to combine the teachings of Shan with the teachings of Ohmi and apply a static magnetic to the apparatus of Ohmi.

Furthermore, even if one were to modify the apparatus of Shan to include a static magnetic field, which Applicants do not concede is reasonable, one would not obtain the plasma processing method performed in a plasma processing apparatus as recited in claim 7 as the method requires supplying radio frequency signals with different phases to the first electrode and the auxiliary electrode to create a difference in plasma density between a front surface of the auxiliary electrode and a back surface of the auxiliary electrode to cause electrons in the plasma to drift from the front surface of said auxiliary electrode to the back surface thereof and from the back surface of said auxiliary electrode to the front surface thereof, and to cause the electrons in the plasma to circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof.

Clearly, neither Shan nor Ohmi, alone or in combination, disclose, teach or suggest supplying radio frequency signals with different phases to the first electrode and the auxiliary electrode. Furthermore, the electrons in the plasma would not drift from a front surface of the process kit 220 of Shan to the back surface of the process kit 220 and from the back surface of the process kit 220 to the front surface thereof, and to cause the electrons in the plasma to circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof, because the extension 226 of the "L-shape" structure would hinder the movement of electrons and the electrons in the plasma circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof.

Consequently, neither Shan nor Ohmi, alone or in combination, disclose, teach or suggest the subject matter recited in claim 7. Therefore, Applicants respectfully submit that claim 7 is patentable over Shan and Ohmi. Reconsideration and withdrawal of the rejections based upon these references are respectfully requested.

Claim 10 was rejected under 35 U.S.C. § 103(a) as being unpatentable over US Patent No. 4,950,956 to Asamaki et al. ("Asamaki") in view of US Patent No. 6,297,165 to Okumura et al. ("Okumura"). Applicants respectfully traverse this rejection.

As conceded in the Office Action, Asamaki does not disclose, teach or suggest an auxiliary electrode provided on an outer periphery of the first electrode to excite plasma by the auxiliary electrode so as to cause electrons in the plasma to drift from a front surface to a back surface of the auxiliary electrode and from the back surface to the front surface of the auxiliary electrode.

Moreover, Asamaki does not disclose, teach or suggest the auxiliary electrode is operably connected to a second power source and a first electrode operably connected to a first power source and the first electrode is supplied with a first radio frequency and the auxiliary electrode is supplied with a second radio frequency and the first and the second radio frequencies are equal to each other and have different phases thereof. Furthermore, Asamaki does not disclose, teach or suggest the electrons in the plasma drift from the front surface of the auxiliary electrode to the back surface thereof and from the back surface of the auxiliary electrode to the front surface thereof, and the electrons in the plasma circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof. In addition, Asamaki does not disclose, teach or suggest a magnetic field generator configured to apply a static magnetic field to a surface of the substrate to which the plasma process is applied.

Okumura fails to overcome the deficiencies noted in Asamaki. Okumura merely teaches a ring-form voltage monitoring conductor 11 that is configured to monitor the self-bias potential generated in the substrate 8. The Okumura patent is directed to etching and cleaning methods in which an end of an etching process or cleaning process is determined based on the self-bias potential of the substrate, which is monitored by the voltage monitoring conductor 11 (see Figure 2 and col. 4, line 40 through col. 5, line 38 of Okumura). A high-frequency electric power is supplied to the substrate electrode 7 (which comprises the pedestal 12 and the insulating member 13) and to the voltage monitoring conductor 11. When high-frequency electric power is supplied to a solid material in contact with a plasma, negative DC potentials are generated in the solid material. This DC potential is called self-biasing potential. Since the self-biasing potential on the substrate 8 cannot be measured directly, measuring the self-biasing potential on conductor 11 is used as a proxy. Thus, in order to replicate the self-biasing potential on the substrate 8, the conductor 11 is driven with high-frequency electric power in the same way as the substrate electrode 7. In addition to applying high-frequency electric power to the substrate electrode 7, a high DC voltage is also applied to the substrate electrode 7 to hold the substrate 8 on the chuck electrode 7. Clearly,

Okumura does not disclose, teach or suggest anywhere that the pedestal 12 is supplied with a first radio frequency and the ring-form voltage monitoring conductor 11 is supplied with a second radio frequency and the first and the second radio frequencies are equal to each other and have different phases thereof.

Contrary to Examiner's contention, Okamura's capacitor 23 is not used to alter the phase but, instead, to break a direct current across the voltage monitoring conductor 11 and the pedestal 12. Without the capacitor 23, a large negative DC voltage would be generated in the pedestal 12, which would induce deterioration of the insulating member 13 (see, col. 5, lines 20-25 in Okumura).

Furthermore, contrary to Examiner's contention, there is no suggestion, in either Okumura or Asamaki, or in the combination of Okumura and Asamaki, to modify the apparatus of Asamaki to contain the ring-form voltage conductor of Okumura. Moreover, Okamura's ring-form voltage monitoring conductor 11 is used for a completely different purpose than the auxiliary electrode of claim 10. By applying a specific voltage to conductor 11, by using the electronic circuit depicted in Figure 3, Okumura monitors the self-bias potential generated in the substrate 8. Okumura does not disclose, teach or suggest applying voltages having a same frequency but with different phases to the pedestal 12 and conductor 11.

In fact, Okumura teaches away from controlling the drift of electrons, as recited in claim 10, by specifically teaching that the electrode 11 is provided with a specific voltage using a specific electronic circuit in order to measure the self-biasing potential on substrate 8. Applicants respectfully submit that it is improper to combine references where the references teach away from their combination, *In re Grasselli, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983)*. See MPEP §2145XD2.

Even if one were to modify the apparatus of Asamaki to incorporate the structure of Okumura and apply a magnetic field to the structure of Okumura, which Applicants do not concede is reasonable, the electrons in the plasma would not drift as recited in claim 10 because of the specific voltages applied to pedestal 12 and conductor 11 and because of presence of the high DC voltage in the substrate electrode 7. Indeed, the flow of electrons would be perturbed by the high DC potential field produced in the vicinity of the back surface of substrate electrode 7 and this would hinder, not encourage, the flow the electrons. Moreover, the magnetic field generated in Asamaki's apparatus is a rotating magnetic field. Thus, the magnetic field in the apparatus of Asamaki is completely different from the static

magnetic field recited in claim 10 and would inherently produce a different effect on the electrons than the flow recited in claim 10. Even if the magnetic field source of Asamaki could be configured to produce a static magnetic field, which Applicants do not concede is reasonable, the presence of the high DC potential produced in the vicinity of the back surface of the substrate electrode 7 would hinder the flow of electron as recited in claim 10.

Consequently, neither Asamaki nor Okumura, alone or in combination, may be said to disclose, teach or suggest the subject matter recited in claim 10. Therefore, Applicants respectfully submit that claim 10 is patentable. Reconsideration and withdrawal of the rejection based upon Asamaki and Okumura is respectfully requested.

Claims 8 and 9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Asamaki in view of Okumura and further in view of Dornfest. Applicants respectfully traverse this rejection.

Asamaki does not disclose, teach or suggest a first power source operably connected to a first electrode and a second power source, an auxiliary electrode is operably connected to the second power source, and the auxiliary electrode is provided on an outer periphery of the first electrode to excite plasma by the auxiliary electrode so as to cause electrons in the plasma to drift from a front surface to a back surface of the auxiliary electrode and from the back surface to the front surface of the auxiliary electrode, and to cause the electrons in the plasma to circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof, as claimed in claims 8 and 9. Furthermore, Asamaki does not disclose, teach or suggest a front surface of the auxiliary electrode is covered by an insulating material such that a difference in plasma density is created between the front surface of the auxiliary electrode and a back surface of the auxiliary electrode, as claimed in claim 8. In addition, Asamaki does not disclose, teach or suggest the front surface of the auxiliary electrode is covered by an insulating material and the back surface of the auxiliary electrode is not covered by the insulting material such that a difference in plasma density is created between the front surface of the auxiliary electrode and the back surface of the auxiliary electrode, as claimed in claim 9. Also, Asamaki does not disclose, teach or suggest a magnetic field generator configured to apply a static magnetic field to a surface of the substrate to which the plasma process is applied. The power sources 35 and 36 in Asamaki used to power the magnetic coils have phases that are shifted by 90° and produce a

rotating magnetic field. Thus, the magnetic field of Asamaki is completely different from the static magnetic field of claims 8 and 9.

Okumura fails to overcome the above noted deficiencies in Asamaki. As discussed, the ring-form voltage monitoring conductor 11 of Okumura is used for a completely different purpose than the auxiliary electrode of claims 8 and 9. In fact, Okumura teaches away from controlling the drift of electrons as recited in claims 8 and 9 by specifically teaching that the electrode 11 is used to measure the self-biasing potential on substrate 8. Furthermore, the capacitor 23 in the apparatus of Okumura is not used to alter the phase but to break a direct current across the voltage monitoring conductor 11 and the pedestal 12. Without the capacitor 23, a large negative DC voltage would be generated in the pedestal 12 which would induce deterioration in the insulating member 13 (see, col. 5, lines 20-25 in Okumura). Thus, neither Asamaki nor Okumura, alone or in combination, disclose, teach or suggest the subject matter recited in claims 8 and 9.

Dornfest fails to overcome the deficiencies noted above in the combination of Asamaki and Okumura. In addition, Dornfest merely uses an insulating material to protect an electrode from the plasma atmosphere. In contrast, in claims 8 and 9, the front surface of the auxiliary electrode is covered by an insulating material. As a result, a difference in plasma density is created between the front surface (covered with the insulating material) and the back surface. This difference in plasma density at least partially causes the electrons to drift between the front and the back surfaces of the auxiliary electrode. Therefore, Applicants respectfully submit that claims 8 and 9 are patentable over the combination of Asamaki, Okumura and Dornfest.

Reconsideration and withdrawal of the rejections based upon Asamaki, Okumura and Dornfest are respectfully requested.

Claim 7 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Asamaki, Okumura in view of WO 98/39500 to Ohmi et al. ("Ohmi"). Applicants respectfully traverse this rejection.

Claim 7 recites, *inter-alia*, "supplying radio frequency signals with different phases to the first electrode and the auxiliary electrode, thereby creating a difference in plasma density between a front surface of the auxiliary electrode and a back surface of the auxiliary electrode to cause electrons in the plasma to drift from the front surface of said auxiliary electrode to the back surface thereof and from the back surface of said auxiliary electrode to the front surface thereof, and to cause the electrons in the plasma to circulate substantially parallel to

the front surface of the auxiliary electrode and substantially parallel to the back surface thereof."

As discussed above, Applicants submit that the combination Asamaki and Okumura does not disclose, teach or suggest "supplying radio frequency signals with different phases to the first electrode and the auxiliary electrode, thereby creating a difference in plasma density between a front surface of the auxiliary electrode and a back surface of the auxiliary electrode to cause electrons in the plasma to drift from the front surface of said auxiliary electrode to the back surface thereof and from the back surface of said auxiliary electrode to the front surface thereof, and to cause the electrons in the plasma to circulate substantially parallel to the front surface of the auxiliary electrode and substantially parallel to the back surface thereof." Furthermore, as conceded in the Office Action, neither Asamaki nor Okumura disclose or suggest a plasma processing method including applying a static magnetic field.

There is no suggestion in Asamaki, Okumura or Ohmi to modify the teachings of Asamaki taken in combination with Okumura to apply a static magnetic field. Furthermore, even if one were to modify the apparatus of Asamaki to include a static magnetic field, which Applicants do not concede is reasonable, the electrons in the plasma would not drift in the manner recited in claim 7 because none of Asamaki, Okumura or Ohmi, alone or in combination, disclose, teach or suggest supplying radio frequency signals with different phases to the first electrode and the auxiliary electrode, thereby creating a difference in plasma density between a front surface of the auxiliary electrode and a back surface of the auxiliary electrode, as recited in claim 7.

Consequently, none of Asamaki, Okumura and Ohmi, alone or in combination, disclose, teach or suggest the subject matter recited in claim 7. Therefore, Applicants respectfully submit that claim 7 is patentable over the combination of Asamaki, Okumura and Ohmi. Reconsideration and withdrawal of the rejections based upon these references are respectfully requested.

CONCLUSION

In view of the foregoing, the claims are now in form for allowance, and such action is hereby solicited. If any point remains in issue which the Examiner feels may be best resolved through a personal or telephone interview, he is kindly requested to contact the undersigned at the telephone number listed below.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Please charge any fees associated with the submission of this paper to Deposit Account Number 033975. The Commissioner for Patents is also authorized to credit any over payments to the above-referenced Deposit Account.

Respectfully submitted,

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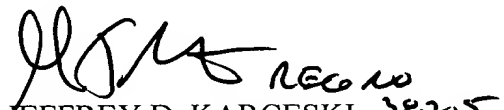

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